

Evaluation of MerCAP™ for Power Plant Mercury Control

Quarterly Technical Progress Report

October 1, 2003 – December 31, 2003

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ABSTRACT

This document summarizes progress on Cooperative Agreement DE-FC26-03NT41993, “Evaluation of MerCAP™ for Power Plant Mercury Control,” during the time-period October 1, 2003 through December 31, 2003. The objective of this project is to demonstrate the performance of the novel Mercury Control via Adsorption Process (MerCAP™) to remove mercury from coal-combustion flue gas. The project is being funded by the U.S. DOE National Energy Technology Laboratory under this Cooperative Agreement. EPRI, the North Dakota Industrial Commission (NDIC), Great River Energy (GRE), and Southern Company are project co-funders. URS Group is the prime contractor.

The general MerCAP™ concept is to place fixed sorbent structures into a flue gas stream to adsorb mercury and then periodically regenerate them and recover the captured mercury. EPRI has shown that gold-based sorbents can achieve high levels of mercury removal in scrubbed flue gases. In this program, tests will be performed at two power plants using gold MerCAP™, installed downstream of either a baghouse or wet scrubber, to evaluate mercury removal from flue gas over a period of 6 months. At Great River Energy’s Stanton Station, gold-coated MerCAP™ plates will be incorporated into one entire compartment of a full-scale baghouse such that flue gas contacts them after passing through the filter bags. At Georgia Power’s Plant Yates (Georgia Power is a subsidiary of The Southern Company), gold-coated plates will be configured as a mist eliminator located downstream of a 1 MWe pilot wet absorber. Additional tests are proposed to determine the ability to repeatedly thermally regenerate exposed gold MerCAP™ plates in a 40-acfm test probe.

The results of this study will provide data required for assessing the feasibility and estimating the costs of a full-scale MerCAP™ process for flue gas mercury removal. It will provide information about optimal operating conditions for different flue gas conditions, the effectiveness of sorbent regeneration, and the ability of the gold sorbent to hold up to flue gas over an extended period. In addition, if successful, the novel approach of incorporating MerCAP™ structures in existing baghouse compartments will demonstrate a cost-effective means for achieving mercury control using existing baghouse technologies.

This is the first full reporting period for the subject Cooperative Agreement. During this period, efforts included kickoff activities and initial planning for Site 1 testing. Work on the design of the Site 1 MerCAP™ installation was also started. This technical progress report provides an update on these efforts.

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INTRODUCTION

This document is the quarterly Technical Progress Report for the project “Evaluation of MerCAP™ for Power Plant Mercury Control,” for the time-period October 1, 2003 through December 31, 2003. The objective of this project is to demonstrate the performance of the novel Mercury Control via Adsorption Process (MerCAP™) to remove mercury from coal-combustion flue gas. The project is being funded by the U.S. DOE National Energy Technology Laboratory under this Cooperative Agreement. EPRI, the North Dakota Industrial Commission (NDIC), Great River Energy (GRE), and Southern Company are project co-funders. URS Group is the prime contractor.

The two utility team members are providing co-funding, technical input, and host sites for testing. GRE is providing the first test site at their Stanton Station (Unit 10), which fires a North Dakota lignite, and Georgia Power (Georgia Power is a subsidiary of The Southern Company) is providing the second site at Plant Yates (Unit 1), which fires low-sulfur bituminous coal. Stanton Station Unit 10 is configured with a spray dryer-baghouse combination. Plant Yates Unit 1 is configured with an ESP followed by a CT-121 Jet Bubbler Reactor (JBR) wet FGD system.

The MerCAP™ mercury control process under development uses regenerable fixed-structure sorbents to remove mercury from coal-combustion flue gas. The sorbent structure is designed to obtain appropriate gas contact to achieve desired mercury removal levels. The sorbent structure is placed directly in the flue gas and subsequently removes mercury until its adsorption capacity is reached. MerCAP™ sorbents can be regenerated using simple thermal methods that enable the captured mercury to be isolated.

This program will evaluate the performance of a gold-based MerCAP™ process. EPRI has shown that gold-based sorbents can achieve high levels of mercury removal in scrubbed flue gases. In this program, tests will be performed at two power plants using gold MerCAP™, installed downstream of either a baghouse or wet scrubber, to evaluate mercury removal from flue gas over a period of 6 months. At Great River Energy’s Stanton Station, gold-coated MerCAP™ plates will be incorporated into one entire compartment of a full-scale baghouse such that flue gas contacts them after passing through the filter bags. At Georgia Power’s Plant Yates, gold-coated plates will be configured as a mist eliminator located downstream of a 1 MWe pilot wet absorber. Additional tests are proposed to determine the ability to repeatedly thermally regenerate exposed gold MerCAP™ plates in a 40-acfm test probe.

The objective of this project is to test previously identified effective gold MerCAP™ sorbents at a larger scale and in a commercial form to provide engineering data for future full-scale designs. The evaluation tests will continue for approximately 6 months at each of two sites to provide longer-term sorbent performance data. After successful completion of the project, it is expected that sufficient test data will be available to design and implement commercial-scale installations of the gold MerCAP™ technology.

The remainder of this report is divided into four sections: an Executive Summary followed by a section that describes Experimental procedures, then sections for Results and Discussion, and Conclusions.

EXECUTIVE SUMMARY

Summary of Progress

The current reporting period, October 1, 2003 through December 31, 2003, is the first full technical progress reporting period for the project. Efforts during the current period focused on tasks associated with initiating and planning the test program. Specific activities included finalization of the project Statement of Project Objectives (SOPO) and Hazardous Waste Plan, project kickoff meetings and host site surveys, initial planning and scheduling for Site 1, and initiation of the MerCAP™ design task for the Site 1 installation. Table 1 lists the planned and completed milestones for the first year of this project. A summary of each activity carried out during this reporting period is provided below.

Table 1. Schedule for Year 1 Milestones for this Test Program.

Milestone	Description	Planned Completion	Actual Completion
1	Hazardous substance plan, Site 1	Q1	Q1
2	Project kickoff meeting	Q1	Q1
3	Site Survey, Site 1	Q1	Q1
4	Site Survey, Site 2	Q1	Q1
5	Test plan – Site 1	Q3*	
6	Complete frame installation & baseline monitoring, Site 1	Q3*	
7	Complete MerCAP™ module installation & intensive testing, Site 1	Q3*	
8	Begin long-term testing, Site 1	Q4*	
9	Hazardous substance plan, Site 2	Q4	

*- Schedule modified from original proposed plan

A final Statement of Project Objectives (SOPO) document for this program was prepared and submitted to NETL and distributed to the project team. This document summarized the plans for the test program including a list of parametric and regeneration tests that will be carried out along with the long-term MerCAP™ performance tests. Stanton Station was identified in the SOPO as Site 1 and Plant Yates will be Site 2. A Hazardous Waste Plan for Site 1 was also prepared and submitted to NETL.

Two project meetings were held during this reporting period. A DOE Contractors' Meeting was held on November 20, 2003 in Pittsburgh to discuss all of the upcoming mercury control programs being carried out under this solicitation. Attending team members from this program

included NETL, EPRI, Apogee Scientific, ADA-ES, and URS. A project-specific kick-off meeting was held on December 10, 2003. A web-cast platform was used for this meeting and members from each participating organization participated. The meeting was used to establish project objectives, schedules, and action items.

Site visits and surveys were conducted at both host power plants during this reporting period. The Site 1 survey was conducted by Apogee Scientific staff in November 2003. Site 2 was visited by URS and EPRI staff during November. In both cases, meetings were held with plant and utility personnel to discuss the upcoming test program. Discussions included program objectives, planned test schedules, expected on-site staffing requirements, health & safety issues, and issues related to process sampling. Additional discussions included expected plant support requirements including those associated with required utilities for testing and requested plant process data. Test locations at each plant were walked down and required modifications for MerCAP™ test installations were identified.

Project Planning and Scheduling

Initial project planning was carried out during this reporting period. This included determination of detailed testing activities summarized in the SOPO. The originally proposed test schedule included startup at Site 1 during early 2004. However, it was determined that it would be beneficial to this program to obtain additional information pertaining to the performance of different gold-coated substrates at Site 1 prior to performing long-term testing. Existing data shows effective long-term performance of gold-coated substrates in small-scale tests conducted at Site 1. It is believed that other gold substrates may provide enhanced, more cost-effective mercury removal performance over previously tested substrates; test data does not exist to verify this, however.

EPRI has agreed to fund a preliminary parametric test program to evaluate the performance of different gold substrates at Site 1. The objective of these tests will be to evaluate how substrate surface area and gold coating thickness affects performance. Apogee Scientific will carry out these parametric tests for EPRI during Quarter 2. The results of these tests will provide an added level of confidence to the NETL-funded program and will be used to determine the final MerCAP™ design for Site 1. Since the preliminary test data will not be available until late in the second quarter, the Site 1 test plan is currently scheduled to be completed during April 2004; this will enable inclusion of actual gold substrate and installation design to be included in the test plan document.

Two other issues will impact the Site 1 testing schedule. The first is a scheduled test burn at Site 1 during May 2004 in which the fuel source will not be consistent with that normally fired. The second issue is associated with currently scheduled activated carbon injection (ACI) tests being performed as part of another NETL-funded mercury control project and planned for early June 2004. Since it is desirable to evaluate MerCAP™ performance during normal unit operation, it will not be desirable to carry out the long-term test while these other events are occurring. Therefore, the current schedule for starting the Site 1 Stanton MerCAP™ performance test is in early July 2004 (Quarter 4). This schedule change is reflected in Table 1 above.

Site 1 MerCAP™ Design

The design task for the Site 1 MerCAP™ installation was initiated during this reporting period. The conceptual design for this installation is shown in Figure 1. An array of gold-coated plates will be configured at the outlet of a single compartment within the Unit 10 baghouse at Site 1. The design for the control unit will be based on the gas flow and temperature conditions at that location, desired mercury removal, and structural limitations at the test locations. The design will include sampling locations for evaluating mercury removal performance. Initial design work has been performed based on data obtained during the on site visit. The design will be finalized pending the results of the EPRI-funded parametric test program.

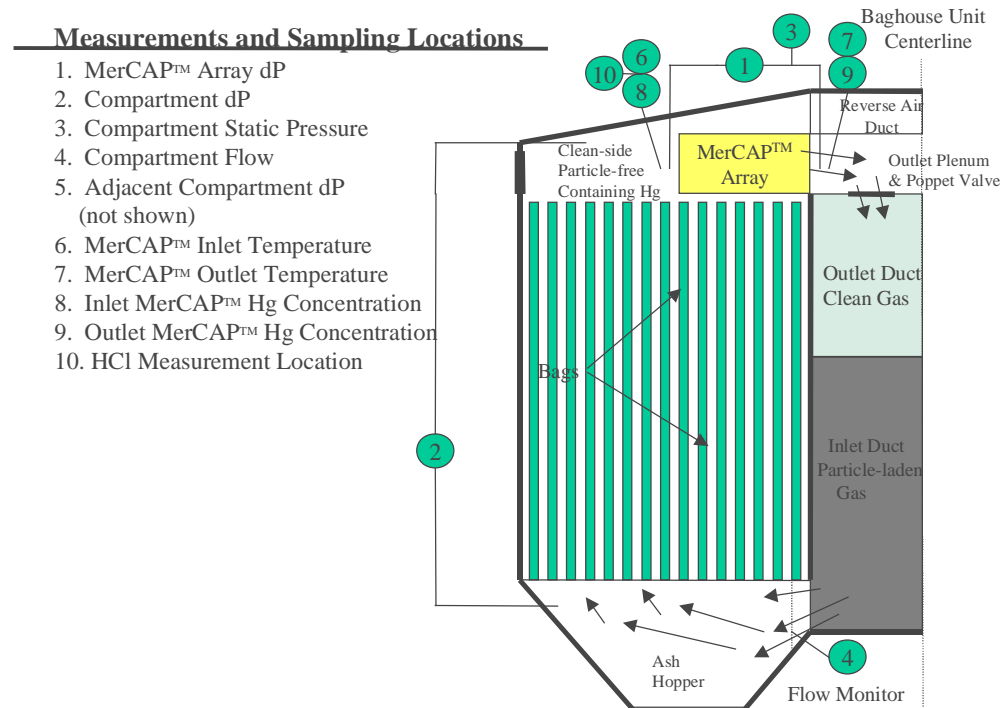


Figure 1. Conceptual Design for Site 1 MerCAP™ Installation.

Sub-Contracts

Subcontracts were issued during the current reporting period to Apogee Scientific Incorporated and ADA-Environmental Solutions, Incorporated (ADA-ES). Both groups were proposed as key team members for this program in the initial proposal to NETL. Apogee Scientific will provide primary support for Site 1 testing as well as general design support for the entire project. ADA-ES will provide technical support related to the planning, data review & interpretation, and reporting for the entire project.

Task Activity Summary

Table 2 lists the current activity status of the primary tasks for this program. Recent modifications to the test schedule have resulted in delays with activities associated with project planning and testing at Site 1. This has resulted in an overall delay with the execution of this project. The current plan is to start installation of the Site 1 MerCAP™ unit during June 2004. The final test plan and site health & safety plan will be completed once the current EPRI-funded test program at Site 1 is completed. Although no testing has yet occurred at Site 1, considerable progress has been made with the design of the MerCAP™ installation; this design will be completed during the next reporting period pending results of the on-going study.

Table 2. Project Activity Status

Task Number	Description	Planned % Completion	Actual % Completion
1	Project Planning	50%	20%
2	Stanton MerCAP Testing	6%	4%
3	Yates MerCAP Testing	0%	0%
4	Economic Analysis	0%	0%
5	Project Management & Reporting	8%	5%

Problems Encountered

There were no significant new problems encountered during the reporting period.

Plans for Next Reporting Period

The next reporting period covers the time-period January 1 through March 31, 2004. The primary activity during this period that impacts this program will be completion of the EPRI-funded parametric tests at Site 1. The results of these tests will be used to finalize both the Site 1 Test Plan and the final MerCAP™ structural design.

Prospects for Future Progress

During the subsequent reporting period (April 1 through June 30, 2004), the Site 1 Test Plan will be finalized and fabrication and installation of the Site 1 control module will be carried out. It is anticipated that the installation will be completed during the early portion of the subsequent reporting period (e.g., July 2004) with long-term testing to start immediately afterwards. The long-term test will be preceded by a baseline testing period that will include intensive flue gas characterization tests. This schedule would result in MerCAP™ testing at Site 1 running into early 2005.

MerCAP testing at Site 2 should commence during early 2005. Thus, the design and fabrication of the Site 2 test module will begin during the October 1 to December 31, 2004 reporting period.

EXPERIMENTAL

This technical progress report covers the first reporting period for this program. Performed activities have been primarily associated with kicking off and planning the project. Thus, no experimental work was conducted during this reporting period.

RESULTS AND DISCUSSION

No technical results are yet available for this program.

CONCLUSION

Initial planning for this program, including a project kickoff meeting and site visits to both host power plants, was carried out during this first project reporting period. The schedule for Site 1 testing has been modified from the originally proposed plan to enable results from an EPRI-funded parametric test program to be obtained; this information will be used to complete the Site 1 Test Plan and test module design.